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EXAMINER	
KIM, DAVID S	

ART UNIT	PAPER NUMBER
2613	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	09/560,723	WATANABE, SHIGEKI	
	Examiner	Art Unit	
	DAVID S. KIM	2613	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 January 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,6-9 and 12-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,6-9 and 12-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Art Unit: 2613

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. **Claims 21-28** are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Regarding claim 21, notice the following limitation:

> "said second optical fiber comprises a plurality of small sections, said plurality of said small sections being connected in such an order that adjacent small sections have similar zero-dispersion wavelengths, each small section being ***shorter than one kilometer***" (emphasis Examiner's).

This limitation appears to correspond to p. 15, last paragraph – p. 16, 1st full paragraph of Applicant's specification. However, the portion of "shorter than one kilometer" is not disclosed. Rather, Applicant's specification states, "hundreds of meters or less"). Accordingly, this limitation constitutes **new matter.**

Claims 22-28 all contain similar new matter, as well.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. **Claims 1, 3, 6, 8, 9, 12-17** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo 10/97 ("All-optical fiber signal processing and regeneration for soliton communications", hereinafter "Bigo 10/97"), with reference to Ramaswami et al. (*Optical Networks: A Practical Perspective*, hereinafter "Ramaswami") and Smith (U.S. Patent No. 5,548,433, hereinafter "Smith '433"), and in view of Watanabe (U.S. Patent No. 5,596,667, hereinafter "Watanabe '667").

Regarding claim 1, Bigo 10/97 discloses:

An optical apparatus (Fig. 9) comprising:

an optical path (path from data input to clock output in Fig. 9) provided between an input port (data input in Fig. 9), which is connected to a first optical fiber (waveguide input into Fig. 9 is conventionally an optical fiber), and to which signal light modulated at a frequency f_s (p. 1215, col. 1, 2nd paragraph) is supplied, and an output port (clock output in Fig. 9); and

an optical loop (loop in Fig. 9) optically coupled to said optical path;

said optical loop including:

an optical amplifier (EDFA in loop in Fig. 9) for compensating for a loss in said optical loop so that laser oscillation of a continuous wave having a wavelength λ_c (λ_c in Fig. 9) occurs in said optical loop;

an adjuster (optical delay line in Fig. 9, p. 1215, col. 1, 1st paragraph) for adjusting an optical path length of said optical loop so that said frequency f_s becomes equal to an integral multiple of the reciprocal of a recirculation period of said optical loop;

an optical bandpass filter (filter in loop in Fig. 9) that allows light having said wavelength λ_c only to pass; and

a nonlinear optical medium (p. 1214, col. 2, last paragraph – p. 1215, col. 1, 1st paragraph) for mode-locking said laser oscillation according to said signal light,

wherein said nonlinear optical medium includes an element ("intracavity modulator" on p. 1215, col. 1, 1st paragraph) to which said signal light of said input port is inputted from said optical loop (e.g., signal light input "Soliton data" is input into the "intracavity modulator"), and said continuous wave having said wavelength λ_c is inputted from said optical loop (light of λ_c is input into the "intracavity modulator"), and generates amplitude modulated CW light (note that said modulation by said nonlinear optical medium is performed on said continuous wave, which would result in modulated CW, or continuous wave, light; also, notice the amplitude modulated CW light "Clock" in Fig. 10) having said wavelength λ_c and including a component of said frequency f_s (Fig. 9, note that the light of wavelength λ_c has the same 20 Gb/s / 20 GHz frequency component as the input signal light) by performing amplitude modulation of said continuous wave (the amplitude modulated CW light "Clock" in Fig. 10 shows that the CW light was amplitude modulated), and

wherein pulses including said wavelength λ_c are generated by said nonlinear optical medium and output through the output port (λ_c clock output in Fig. 9), and a wavelength λ_s of said signal light of said input port is different from said wavelength λ_c of said continuous wave (signal light wavelength of 1555 nm is different from clock wavelength of 1548 nm on p. 1215, col. 1, 1st full paragraph).

Bigo 10/97 does not expressly disclose:

wherein said element of said nonlinear optical medium is a ***second optical fiber***, and

wherein said "amplitude modulation of said continuous wave" is ***based on four-wave mixing between the signal light and the continuous wave generated by the laser oscillation using said signal light as pump light***.

However, notice that Bigo 10/97 teaches that the nonlinear optical medium may be embodied by a variety of modulators (p. 1215, col. 1, end of 1st paragraph), such as an amplitude/intensity modulator (NOLM in abstract) or a phase modulator (KFM in abstract). Generally speaking, notice that the operating principle of Bigo 10/97 involves the principle of a mode-locked laser (p. 1213, col. 2, last paragraph). As a reference, Ramaswami teaches that amplitude or frequency/phase modulation can be used to achieve mode lock (p. 141, 4th full paragraph). As another reference, Smith '433 also confirms that one can modulate the amplitude or phase of the light in the laser cavity to achieve mode lock (col. 6, l. 52-64). Accordingly, it follows that a suitable amplitude modulator or a suitable phase modulator would provide obvious variations.

Consider the amplitude modulator of Watanabe '667 (e.g., Fig. 30, col. 26, l. 3 – col. 27, l. 6). It comprises an optical fiber as a nonlinear optical medium (col. 27, l. 63-64) and it performs amplitude modulation based on four-wave mixing (FWM). At the time the invention was made, it would have been obvious to one of ordinary skill in the art to implement the amplitude modulator of Watanabe '667 as a suitable amplitude modulator for the mode lock principle of Bigo 10/97. One of ordinary skill in the art would have been motivated to do this such amplitude modulation of Watanabe '667 is another example of an all-optical modulation process (Watanabe '667, e.g., notice that the modulation in Fig. 30 occurs due to the interaction of all-optical signals in the non-linear optical medium of 303), such as the NOLM and

KFM of Bigo 10/97, and "all-optical implementation is attractive because it removes the electronics bottleneck" (Bigo et al. 10/97, p. 1220, col. 2, 1st paragraph under Section V). Also, as stated above, a suitable amplitude modulator would provide an obvious variation.

Regarding claim 3, Bigo 10/97 in view of the references applied above (hereinafter the "RAA") discloses:

An optical apparatus according to claim 1, further comprising an optical coupler (50/50 coupler in Fig. 9) for optically coupling said optical path and said optical loop, said optical coupler providing a part of said optical path and a part of said optical loop.

Regarding claim 6, Bigo 10/97 in view of the RAA discloses:

An optical apparatus according to claim 1, wherein said nonlinear optical medium comprises a single-mode fiber (Watanabe '667, col. 28, l. 8-11).

Regarding claim 8, Bigo 10/97 in view of the RAA discloses:

An optical apparatus according to claim 6, wherein said nonlinear optical medium has a zero dispersion wavelength substantially equal to the wavelength of said signal light (Watanabe '667, col. 28, l. 14-16, 45-47).

Regarding claim 9, Bigo 10/97 in view of the RAA discloses:

An optical apparatus according to claim 1, further comprising an input optical amplifier (EDFA connected to data input in Fig. 9) optically connected to said input port for amplifying said signal light.

Regarding claim 12, Bigo 10/97 in view of the RAA discloses:

An optical apparatus according to claim 1, further comprising a waveform shaper (NOLM in Fig. 11) optically connected to said output port for performing waveform shaping of said signal light according to an optical clock output from said output port.

Regarding claim 13, Bigo 10/97 in view of the RAA discloses:

An optical apparatus according to claim 12, wherein said waveform shaper comprises a nonlinear optical loop mirror (NOLM in Fig. 11).

Regarding claim 14, claim 14 is a system claim that corresponds largely to the apparatus claim 1. Therefore, the recited means in apparatus claim 1 read on the corresponding means in system claim 14. Claim 14 also includes a limitation absent from claim 1. This limitation is:

a first optical fiber for transmitting signal light modulated at a frequency f_s; and

the second optical fiber included in the optical loop.

Bigo 10/97 also discloses such a first optical fiber (line input to "1:2 clock recovery" unit in Fig. 11 is conventionally an optical fiber) and, in view of the RAA, the second fiber optical fiber included in the optical loop (Watanabe '667, col. 27, l. 63-64).

Regarding claims 15-16, claims 15-16 are system claims that correspond largely to the apparatus claims 12-13, respectively. Therefore, the recited means in apparatus claims 12-13 read on the corresponding means in system claims 15-16. Claims 15-16 also include limitations absent from claims 12-13. These limitations are also disclosed by Bigo 10/97:

a first optical fiber transmission line (optical fiber link on p. 1216, col. 1, last paragraph; input fiber transmission line to Fig. 11) for transmitting signal light; and

at least one optical repeater (regenerator stage on p. 1216, col. 2, 1st paragraph; e.g., Fig. 11) arranged along said optical fiber transmission line;

each of said at least one optical repeater comprising:

an optical clock regenerator (Fig. 9., p. 1216, col. 2, 1st paragraph) for regenerating an optical clock by mode locking of laser oscillation according to said signal light;

said optical clock regenerator (Fig. 9) including:

an optical path provided between an input port (input port in Fig. 9), which is connected to said first optical fiber (input port in Fig. 9, i.e., the clock recovery unit, is connected to the input fiber transmission line to Fig. 11), and to which signal light modulated at a frequency f_s (p. 1215, col. 1, 2nd paragraph) is supplied, and an output port (clock output in Fig. 9).

Regarding claim 17, claim 17 is a method claim that corresponds to apparatus claim 1. Therefore, the recited means in apparatus claim 1 read on the corresponding steps in method claim 17.

4. **Claims 7 and 18** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo 10/97 in view of the RAA, as applied to claim 1 above, further in view of Watanabe et al. ("Simultaneous wavelength conversion and optical phase conjugation of 200 Gb/s (5x40 Gb/s) WDM signal using a highly nonlinear fiber four-wave mixer", hereinafter "Watanabe 9/97").

Regarding claim 7, Bigo 10/97 in view of the RAA does not expressly disclose:

An optical device according to claim 1, wherein said nonlinear optical medium comprises a highly nonlinear dispersion shifted fiber.

Watanabe 9/97 teaches such a nonlinear optical medium (Watanabe 9/97, p. 1-2). At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to incorporate a highly nonlinear dispersion shifted fiber as the nonlinear optical medium of Bigo et al. 10/97 in view of the RAA. One of ordinary skill in the art would have been motivated to do this since doing so would enable one to practice the optical device of Bigo et al. 10/97 in view of the RAA with a shorter length of fiber, providing a more compact optical device. Also, a highly nonlinear dispersion shifted fiber can have a higher third-order nonlinear coefficient than ordinary dispersion shifted fiber (Watanabe 9/97, p. 2, 1st full paragraph). A higher coefficient value leads to higher conversion efficiency (Watanabe 9/97, p. 1, last paragraph).

Regarding claim 18, Bigo 10/97 in view of the RAA discloses:

An optical device according to claim 7, wherein said nonlinear optical medium has a zero-dispersion wavelength substantially equal to the wavelength of said signal light (Watanabe 9/97, p. 1, last paragraph).

5. **Claims 19-28** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bigo 10/97 in view of the RAA and Watanabe 9/97, as applied to claim 7 above, and further in view of Watanabe (WO98/08138, but Examiner references the English translation in U.S. Patent No. 6,307,984 B1, hereinafter WatanabeWO).

Regarding claims 19-20, Bigo 10/97 in view of the RAA and Watanabe 9/97 discloses:

An optical device according to claim 1, wherein said second optical fiber comprises a highly-nonlinear dispersion shifted fiber (see treatment of claim 7 above).

However, Bigo 10/97 in view of the RAA and Watanabe 9/97 does not expressly disclose:

(claim 19) a nonlinear refractive index of said second optical fiber is equal to or larger than $5x10^{-20}$ m^2/W.

(claim 20) a mode field diameter of said second optical fiber corresponding to an effective core area is equal to or less than 4 μm.

However, first of all, Applicant does not appear to characterize these parameter values as inventive or effective to provide patentably unexpected results (Applicant's specification, p. 12-13, bridging paragraph). Rather, Applicant discusses them as exemplary parameter values for highly-nonlinear dispersion shifted fiber.

Additionally, these parameters are known values of highly-nonlinear dispersion shifted fiber, as shown by WatanabeWO (col. 24, l. 34-52) as part of a discussion of how to increase the nonlinear coefficient. At the time the invention was made, it would have been obvious to one of ordinary skill in the art to employ these parameter values in the apparatus of Bigo 10/97 in view of the RAA and Watanabe 9/97. One of ordinary skill in the art would have been motivated to do this since Bigo 10/97 in view of the RAA and Watanabe 9/97 is relatively silent about an exemplary nonlinear refractive index and an exemplary mode field diameter of said second fiber; WatanabeWO's teachings speak into this silence by providing structural details and techniques (col. 24, l. 34-52) for proper implementation of the apparatus by one of ordinary skill in the art.

Regarding claim 21, Bigo 10/97 in view of the RAA and Watanabe 9/97 does not expressly disclose:

An optical device according to claim 1, wherein said second optical fiber comprises a plurality of small sections, said plurality of said small sections being connected in such an order that adjacent small sections have similar zero-dispersion wavelengths, each small section being shorter than one kilometer.

However, WatanabeWO discloses this kind of fiber (col. 26, l. 4-21). At the time the invention was made, it would have been obvious to one of ordinary skill in the art to provide this kind of fiber in the apparatus of the prior art of record. One of ordinary skill in the art would have been motivated to do this

since WatanabeWO's fiber helps maintain the phase matching condition of the lights involved in the FWM of the prior art of record over the overall length of the fiber (WatanabeWO, col. 25, l. 56 – col. 26, l. 21), which helps make the FWM of the prior art of record occur effectively (WatanabeWO, col. 25, l. 34-36).

Regarding claims 22-24, claims 22, 23, and 24 introduce limitations that correspond to the limitations introduced by claim 21. Therefore, the recited limitations in claims 21 read on the corresponding limitations in claims 22-24.

Regarding claim 25, Bigo 10/97 in view of the RAA, Watanabe 9/97, and WatanabeWO does not expressly disclose:

An optical device according to claim 21, wherein fiber sections among said plurality of said small sections have a smaller variation in zero-dispersion wavelength near an end of said second optical fiber, to which end said signal light is input.

However, WatanabeWO discloses this arrangement (col. 26, l. 22-35). At the time the invention was made, it would have been obvious to one of ordinary skill in the art to provide this arrangement in the apparatus of the prior art of record. One of ordinary skill in the art would have been motivated to do this since WatanabeWO's arrangement helps provide an increased conversion band (WatanabeWO, col. 26, l. 22-35), which is related to the amount of ease of making the wavelength of pump light coincide accurately with the zero dispersion wavelength of the dispersion shifted fiber of the prior art of record (WatanabeWO, col. 24, l. 22-33), which helps maintain the phase matching condition of the lights involved in the FWM of the prior art of record over the overall length of the fiber (WatanabeWO, col. 25, l. 56 – col. 26, l. 21), which helps make the FWM of the prior art of record occur effectively (WatanabeWO, col. 25, l. 34-36).

Regarding claims 26-28, claims 26, 27, and 28 introduce limitations that correspond to the limitations introduced by claim 25. Therefore, the recited limitations in claims 25 read on the corresponding limitations in claims 26-28.

Art Unit: 2613

Response to Arguments

6. Applicant's arguments with respect to the independent claims (REMARKS, p. 8-10) have been considered but are moot in view of the new ground(s) of rejection. In particular, notice the treatment of claim 1 for more details.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DAVID S. KIM whose telephone number is (571)272-3033. The examiner can normally be reached on Mon.-Fri. 9 AM to 5 PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth N. Vanderpuye can be reached on 571-272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/D. S. K./
Examiner, Art Unit 2613

/Kenneth N Vanderpuye/

Supervisory Patent Examiner, Art Unit 2613